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Beechcraft

PROTOTYPE DEVELOPMENT
MODEL 385 AIR REFUELING STORE

April 8, 1963

Prepared Under Navy, Bureau of Naval Weapons

Contract NOW 60-0060-c

Interim Report No. 34

Engineering Report 4720

1 March 1963 Through 31 March 1963

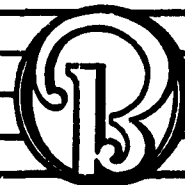
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BEECH AIRCRAFT CORPORATION

WICHITA 1, KANSAS, U. S. A.





Beech Aircraft Corporation

Wichita, Kansas

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ABSTRACT

Activity during the month of March, 1963, in the development of the Beech Model 385 Air Refueling Store has consisted primarily of Navy flight tests on the F-4 aircraft. Stowed flight up to Mach 1.1 was achieved satisfactorily during ferry flight of the store to Patuxent. Three operational flights were accomplished at NATC with only partial success. Satisfactory extend/retract function occurred at 250 knots, however, cable system malfunctions were encountered at 300 knots. Satisfactory engagements were achieved by an A-4 receiver, however, difficulties were encountered with the F-8. Fuel transfer was satisfactory with the F-8 but unsuccessful with the A-4. Navy evaluation has been temporarily suspended pending incorporation of store modifications to correct the problems encountered.



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STATEMENT OF WORK (1 March 1963 Through 31 March 1963)

Navy evaluation of the prototype Model 385 Air Refueling Store was started during this period. The store was flown on an F4B aircraft to the Naval Air Test Center at speeds up to Mach 1.1, completing that portion of the evaluation. Three refueling flights were accomplished at Patuxent on the F4B with only partial success. The store cable system functioned properly at extensions below 250 KEAS but malfunctioned on extensions above 275 KEAS. Engagements were normal using A4D aircraft but difficulties were encountered with the F8U aircraft. Fuel transfer to the F8U on "automatic" operations of the store appeared normal, but fuel transfers on store "manual" to the A4D were unsuccessful.

Further evaluation testing has been suspended pending resolution of these problem areas; the store has been returned to Beech for repair, modification, and further development testing. Corrective design is in process; it is indicated that Navy evaluation can be resumed in May, 1963. A total of 7 engineers are presently working on corrective modifications and preparation for testing. The proposed program phases for compatibility testing on the A-4 aircraft and for manufacture of additional prototype stores have remained static during this interim period, pending receipt of BuWeps go-ahead.

Prototype store No. P-2 was installed on an F4B aircraft at McDonnell AFB, Wichita, Kansas, on March 13, 1963, and ferried to Patuxent for Navy evaluation testing. Airspeeds up to 500 KEAS and Mach 1.1 were attained during the ferry flight. Pilot reported slight buffet when going through Mach 1.0.

An operational flight was conducted on March 15, 1963, at 20,000 feet and 300 KEAS, using an F-8 aircraft as receiver. Store was operated through extend, retract and extend at 300 knots. Engagements were then attempted with the F-8, with unsatisfactory results. Difficulty was then encountered in an attempt to retract, requiring special manipulation of store controls. The resulting retraction consisted of complete stowage, except that the drogue was not collapsed.

Examination of the store following this flight indicated that the hose retract cable had gone slack on its drum during the last extend cycle, resulting in incomplete extension. This condition resulted in electrical interlock of the extend relay, requiring manipulation of the store master switch to complete circuitry for retraction. During the retract cycle, one turn of cable was lost from the hose retract cable drum, resulting in incomplete stowage of the drogue. Evidence was found which indicated that a screw head on the reception coupling had snagged in the boom bell-mouth, which could have caused slackening of the cable during extend. In addition to the cable system malfunction, one drogue leaf was broken during engagement attempts by the F-8.

A second flight was conducted on March 15, 1963, at 20,000 feet and 250 knots, with the F-8 receiver aircraft. The store operated satisfactorily through two extend/retract cycles. Several hookups were made with the



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STATEMENT OF WORK (Continued)

F-8 aircraft. During one hookup approximately 800 pounds of fuel was transferred at a rate of 200 gpm. Engagements were discontinued when the refueling hose became kinked immediately forward of the coupling. In addition to the damaged hose, seven drogue leaves were broken during the flight.

It is believed that the drogue damage was caused by interference of the drogue leaves with the slanted probe mast of the F-8. This condition was aggravated by a structural weakness in the drogue leaf. (The particular drogue used during these tests had been previously subjected to nearly 3000 stowage cycles on a ground test rig and may have been partially fatigued.)

A third flight was conducted on March 20, 1963, with initial operating conditions of 20,000 feet and 250 knots and using an A-4 receiver aircraft. Following satisfactory extend/retract cycling and dry hook-ups of the A-4, fuel transfer was attempted. Each attempt at fuel transfer resulted in immediate disconnect of the reception coupling from the receiver probe. After 5 unsuccessful tries, fuel transfer attempts were discontinued. Additional retract, extend and dry hook-ups were accomplished at 275 and 300 knots. Retract difficulties were encountered after the 300 knot operation. Retraction was finally achieved by special manipulation of the store controls, resulting in complete retraction of the boom with approximately 20 feet of hose trailing. The aircraft was landed with the trailing hose. The hose, coupling and drogue were damaged from runway contact during the landing.

Examination of the store, following this flight, revealed that the hose retract cable had broken during the retract cycle. The cable showed evidence of having been entangled in the stowed latch mechanism. It is believed that the cable went slack during the last extend cycle, becoming kinked and damaged such that it failed when retract was attempted. No concrete evidence was found as to the reason for the cable going slack. It is believed that the fuel transfer problem is related to sudden initiation of fuel, with further aggravation of surge by the hose being partially emptied into receiver prior to pump startup. (During this flight, fuel was turned on manually after engagement and approximately 10 feet of hose take-up.)



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STATEMENT OF WORK (Continued)

It was decided at this time to return the store to the manufacturer's facility for repair, modification to resolve the problem areas, and additional testing prior to further evaluation at Patuxent. The following specific modifications are presently being developed; it is indicated that the store will be returned to NATC the latter part of May, 1963.

- (1) Incorporation of independent cable tensioning systems which will accommodate the full cable travel of both drums.
- (2) Addition of guards on the cable drums to prevent cable entanglement.
- (3) Rework of the boom to accommodate a longer "stiff" section in the refueling hose, with improved guidance of coupling in the boom bellmouth. (There is some indication that engagement characteristics were better on the experimental store, which had a longer stiff section in the hose, than on the prototype model.)
- (4) Relocation of the fuel shutoff valve and rearrangement of electrical circuitry to turbine, clutch and fuel valve to allow fuel transfer to start more gradually.
- (5) Replacement of drogue, including a beef up of the leaves in the failure area. In addition, development is in process toward possible shortening of the drogue leaves to improve compatibility with the F-8 probe system.
- (6) Rearrangement of the hose depressurization system to connect to the aircraft store vent fitting.

Design work is nearing completion on the above modifications. The store is presently being installed on the ground test stand for operational testing in its present configuration, to further confirm the problem areas encountered during the recent flight tests. The various modifications will be incorporated as indicated, with additional operational testing to substantiate the changes.



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PROGRAM FOR NEXT MONTH

Development of the Beech Model 385 Air Refueling Store will continue during the month of April, 1963, with major emphasis on resolution of various problems encountered during recent flight tests at NATC. It is expected that design and test investigations related to these problems will be completed during this period, with store modification and operational testing continuing into May.